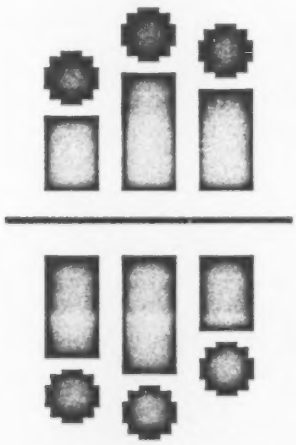
Policy Study Series

Center for Information Technology and Society

EDUCATIONAL TECHNOLOGY: INFORMATION NETWORKS, MARKETS AND INNOVATION

PART III

SURVEY OF TEN EDUCATIONAL SOFTWARE FIRMS: A Study of the Economics of the Market and the Process of Technological Innovation



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W. Curtiss Priest, Director
18 Whipple Rd.
Lexington, MA 02173
617-862-7763

Part I — *General Framework on Markets, Nonprofits, Patrons, and Policy*

Part II — *Information Networks: The Diffusion of Innovation and Highlights of Discussions with Eighteen Networks of Teachers, Administrators, State Coordinators and Other Information Providers*

Part III — *Survey of Ten Educational Software Firms: A Study of the Economics of the Market and the Process of Technological Innovation*

Part IV — *A Survey of Four Firms Involved in Both Educational Software and Business Products*

Part V — *Reference Materials: A Comprehensive Bibliography on Educational Technology, Innovation, Adoption, and Policy* and Appendices

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SURVEY OF TEN EDUCATIONAL SOFTWARE FIRMS:

A STUDY OF
THE ECONOMICS OF THE MARKET
AND THE
PROCESS OF TECHNOLOGICAL INNOVATION

INTRODUCTION

The main purpose of the survey of firms was to understand the economic viablility of the production and sale of educational technology. To gain this understanding each firm was examined in terms of their contribution to technological innovation. The examination first placed the firm in perspective of other firms in terms of parameters such as size and novelty of innovations. Then it examined the market climate that each firm faced for its products.

Before presenting the questions employed in the survey of ten firms, we turn to some background about how these were derived. The background relates to the general literature on the **measurement of innovation** and the literature on **economics of markets** and **types of market failure.**

Background on the Measurement of Innovation

The measurement of innovation in firms is a research activity with considerable history. For a summary, excerpts of *Schools of Approaches in Identifying Innovation* are presented in the study appendices [Priest, 1980]. The survey of firms has been the activity of both 1) individual research studies (such as this one), and 2) more systematic and on-going activities of organizations. Three notable groups are the Science Policy Research Unit (SPRU) at Sussex University (England) [Pavitt, 1976], the Science Council of Canada [Wilson, 1973], and IFO in Germany (Institut fur Wirtshaftsforschung) [IFO, 1980]. These groups maintain on-going databases of innovative activity on large samples of firms (often, though, in traditional industrial sectors). Both the U.S. (National Science Foundation, Science Indicators) and the OECD coordinate research on the topic. The OECD convened a major conference entitled, Science and Technology Indicators Conference, in Sept. 1980 at which over 100 eminent researchers presented papers and discussed the area. In contrast, work at the NSF tends to concentrate on <u>science</u> almost entirely, rather than <u>technology</u>.

In formulating many of the questions for the firm survey, a recent form from IFO, above, was consulted. This form represents a history of combined wisdom as it was constructed after consulting the work of SPRU (above) and others. Working from an established form helps assure completeness and also helps shape the tone of the questions.

Orientation Toward Potential Market Failure

Our particular survey emphasizes aspects of potential market failure. There is, indeed, a similar section in the IFO form, cast in the language of innovation research — *innovation barriers*. However, the questions in the IFO form have a somewhat different orientation and were modified and supplemented. The IFO questions were:

At the present, our innovation efforts are hindered by:

- *secession-phase of the industry in general*
- *poor profit return*
- *lack of capital*
- *lack of credit-financing possibilities*
- *lack of direct innovation subsidies*
- *lack of indirect innovation subsidies*
- *insufficient social acceptance of new technologies*
- *insecurity about the long-range demand within existing and/or new markets*
- *insufficient willingness-to-cooperate on the part of our competitors*
- *insufficient willingness of our customers to introduce innovations*
- *personnel problems, shortage of personnel*
- *lack of innovations by suppliers of*
  intermediate products (materials, components, etc.)
  investment-goods for the production process
- *other (please specify)*

Some of the above IFO questions were *suggestive* of market failure but did not address market failure specifically from the standpoint of an information commodity like educational software. "Poor profit return" could be for any number of reasons. The "lack of subsidies" implies that there is some form of market failure without, again, identifying what it is.

Thus, to improve data collection in the area of market failure an approach to market failure appearing in *The Characteristics of Information* [Priest, 1985] was employed. This approach has been expanded and appears in the economics of information section of this report. In particular, the specific forms of market failure for an information commodity formed the basis of our questions. These market failure categories are:

- o Nonappropriability: can the seller exact payment for the item's use?
- o Nondepletability: does consumption lead to depletion of the item?
- o Externalities: – are there benefits (or costs) to society that are not captured in the selling price?
- o Indivisibilities of supply: is it difficult to separte the product into pieces of the size consumers wish to purchase?
- o Economies of Scale: do decreasing costs of production lead to natural monopolies and artificially high prices?
- o Risk and Uncertainty: is the market predictable?
- o Search: is it difficult to provide (or obtain) information about products?
- o Information on Utility Functions: is it difficult for firms to learn about buyer preferences?
- o Information Asymmetries: Are there reasons firms may purposefully withhold information about their products?
- o Information Transfers Good: In trying to reduce the problems of search does the provision of information about the good serve to provide the potential buyer with the good?
- o Intangibility: can the benefits derived from a product be evaluated in dollar terms?
- o Transaction costs: is it difficult to contract with many buyers?
- o Aggregate Overinvestement: would coordination of development result in less duplication and greater aggregate efficiency?
- o Intergenerational transfers: are the benefits to future generations considered?
- o Equity: are the distributional consequences of the availability of a new product received by by individuals of varying wealth and background equitable and fair?

A Countervailing Force to Market Failure

There are characteristics of information commodities that work to their particular advantage in the market place. In particular, as discussed in the section on economics of information – *high investment to reproduction cost ratios* make the marginal cost of producing additional units extremely low (essentially equal to the cost of marketing). This characteristic helps overcome appropriability, risk and other market failure problems. However, from an allocative efficiency standpoint, this is not a panacea. In economic terms, this represents a form of cross-subsidy that does not cure the problems of market failure – it only serves to **mask** them. Low marginal costs of production may turn an unsuccessful product into a "successful" one, but if market failure hindrances were reduced or eliminated, then that the product would be **even more successful**.

In full economy terms, production and consumption would shift further to this product, Pareto optimality would be improved, and society would be **even better off.**

Enhancements to the Study of Innovation

The study of innovation relates to the study of the **character** of firms. As Nelson and Winter [1977] well described, innovating is an uncertain activity, and inherently risky. Firms differ considerably in their orientation toward uncertain and risky activites and therefore differ considerably in their **ability** to innovate.

Abernathy and Utterback [1976] note that "the firm's capability to contribute to technological innovation is considered a function of its other major characteristics: the development of production technology, organizational structure, market relationships and competitive strategy." They describe a maturation process where firms begin as aggressive product innovators and gradually turn to process innovators (primarily focussing on cost reduction). The more mature firm has more stable and standardized products and implements mainly incremental changes. The following chart and table condenses the information from their paper.

To capture these characteristics of the firm, some of the questions focus on indicators of these characteristics. One is derived from the transition of firms from fluid to rigid as shown in the *Change in a Firm's Innovative Character over Time* figure on the next page. While it is not possible to ask a firm *directly* where they are on the maturation curve, it can be deduced through a discussion about the **character of the firm** (see the topics under this label in the table). A particular area of questioning goes to the novelty or radicalness of the innovation.

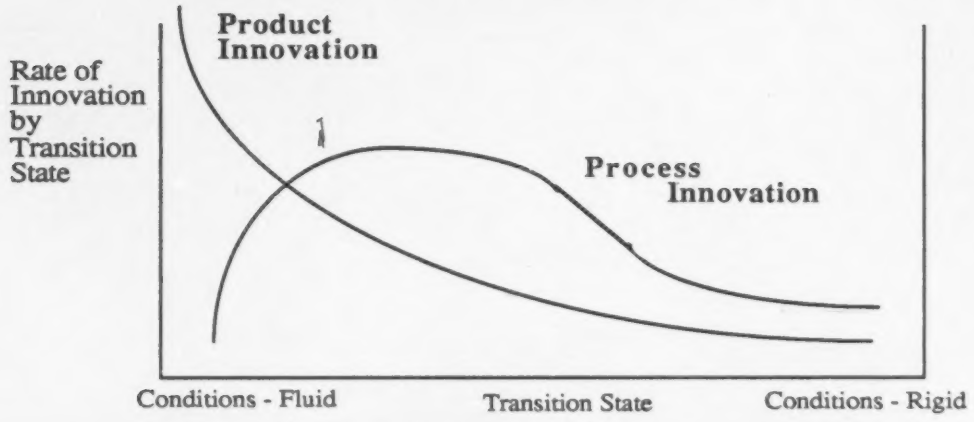
Development of Hypotheses

To make the findings of a survey more robust, it was important to posit a set of hypotheses before collecting the data. This procedure has been a long standing part of the *scientific method* and encouraged in many National Science Foundation projects.

Since we had a model of the innovative character of the firm, it was straightforward to state hypotheses based on the model. For example, we expected a smaller, new firm to show more novelty in their product developments.

A case study, in general, has both anecdotal and statistical value. To draw generalizations from a set of case studies, however, requires statistical rigor that the hypothesis testing approach provides.

Change in a Firm's Innovative Character Over Time



Fluid Characteristics

Innovation

- Emphasis on maximizing product performance
- Stimulated by information on User Needs
- Novelty or radicalness high
- Frequency rapid
- Predominant type is product rather than process

Character of the Firm

- Production process & organization is flexible & inefficient
- Size or scale is small
- General Pupose equipment used
- Available materials used as inputs
- Product is frequently changed or custom designed

Rigid Characteristics

Innovation

- Emphasizes cost reduction
- Predominant mode is incremental for product and process
- Effect is cumulative
- Novel or radical innovations occur infrequently & originate outside process segment
- Stimulation arises from disruptive external forces

Character of Firm

- Production process is efficient, system-like, capital intensive
- Cost of change is high
- Scale & facility market share is large
- Special purpose process equipment used
- Specialized input materials used or vertical integration is extensive
- Products are commodity-like & largely undifferentiated

Source: William J. Abernathy and James M. Utterback, "Innovation and The Evolution of Technology in The Firm," Harvard Business School, HBS 75-16R, June, 1976.

Firm Case-Study Discussion Topics

In gathering information, quantification of responses was performed when possible. In some cases a percentage of allocation was elicted. For questions that were a matter of degree (such as the degree of concern for a particular barrier to innovation), a Likert scale value was used mainly of the form: high, medium, and low]. For numerical information such as sales levels, dollar amounts were obtained.

The complete set of questions employed appears as Appendix C in Part V of this report. The questions covered the following topics for **background**:

Sales levels
Number and type of products
Ownership and organization of the firm
Marketing channels
    Use of representatives
    Direct sales
    Wholesalers, retailers
Levels of R&D funding
Management
    Style of leadership
    Flexibility among staff

The questions also covered the following topics related to the **innovative process**:

Relationship of software to other product lines (type and percentages)
    (Degree of horizontal integration)
Novelty of innovations (degree and percentages)
Areas of innovative activity by product and process (percentages)
    - R&D
    - licenses
    - production
    - sales preparation and marketing
Sources of Innovations (the innovative stimuli)
    Internal
        - R & D
            (Especially "technology push")
        - From production groups
        - Marketing, product-image
            (Especially "market pull")

- "suggestion box", etc.
- the firm's management
- other

External

- suppliers
- customers
- competitors
- federal R&D, federal programs
- affiliated enterprises (e.g. joint ventures)
- exhibitions
- trade literature, associations, conventions, etc.
- acquisition and licensing
- other

Innovation goals

- creation of successor-products to replace any to-be-discontinued products
- rounding out of product mix
- restructuring of production program (organizational changes)
- changing of the number of production stages which firm handles (make/buy)
- reduction of production costs via
  - o proportional reduction of wage costs
  - o decrease in input costs
  - o decrease in lost time
- interest in being a "product leader"
- other (please specify)

And the questions covered the following topics related to *economics of the market* and *market failure*:

Innovation Barriers [for each topic, degree of concern and degree of awareness was collected]

- conditions of the market in general (the economy)
- poor profit return
- lack of capital
- lack of credit-financing possibilities
- lack of subsidies
- problems with acceptance
  - school curricula
  - teacher interests
  - student interests
- insecurity about the long-range demand within existing and/or new markets (risk and uncertainty)
- personnel problems, personnel shortages
- lack of innovations from suppliers

- Other forms of market failure
    - o appropriability (issues of copyright, protection, etc.)
    - o non-depletability (degree older products are hard to replace with newer ones)
    - o externalities (e.g. extent current purchases reflect value to future generations)
    - o Indivisibilities (can the market support more "pieces", smaller chunks of software, etc.)
    - o Economies of scale and scope (e.g. does the small firm feel disadvantaged to the larger firms, ceterus paribus)
    - o Uncertainty and risk [covered above]
    - o Information (awareness of teachers, administrators about usefullness and availability)
    - o Intangibility (are innovations that really help learning appreciated and purchased?)
    - o Transactions Costs (e.g. burden of having to deal with school boards at many levels for curricula changes)

The **proposed hypotheses** for the study were:

1. The more rigid the firm, the less novel will be the innovations
2. The more rigid the firm, the higher the ratio of process to product innovations
3. The more rigid the firm, the greater the percentage of product innovations
4. The larger the firm, the more rigid the firm
5. The larger the firm, the less concern will be expressed on appropriability
6. The more novel the firm, the more concern will be expressed for externalities
7. Indivisibilities will not be of high awareness for any type of firm
8. Publishers will recognize their economies of scale and scope
9. Smaller firms will feel disadvantaged in terms of economies of scale and scope
10. Risks will be of equal awareness but of greater concern to firms with less horizontal integration
11. Firms with more novel innovations will be more concerned about conveying information about their product

Detailed Results of the Survey

The results of the survey are provided in three ways. First, a firm-by-firm description is provided. Second, a cross-tabulation of the results is presented. Third, the proposed hypotheses are examined in light of the survey results.

Firms were chosen randomly, stratified by an indicator of the level of educational software activity — the number of software packages. The Bowker database on microcomputers (Lockheed Dialog) was used to construct the sample. Firms involved in educational software were selected and a randomized selection of 100 firms was produced. Bowker estimates the total number of educational software firms to be close to 900 and the average number of software packages per firm to be around 9-10. The sample was then stratified to have equal numbers of firms in the three categories: small (less than 10 packages); medium (10-50) packages; and large (over 50 packages). Finally, ten firms were chosen from the list of 100, again at random.

Firms were promised anonymity to improve candidness of their replies. To identify each of the ten firms, a code name has been assigned that represents the general character of each firm. All firms contacted were willing to cooperate fully and answer all the questions. Only in a few instances where the inavailability of the right person made response impossible were some back-up selections used.

The interview was conducted with a principal of the firm, either the president, the vice president of marketing, or the product development manager. The majority of the discussions were with the V.P. of marketing.

Early Bird Inc. — V.P. of Marketing

Background and Innovation. The company gets its name by being one of the first companies in the educational software business. Like some of the other firms in the business, they had originally been an educational filmstrip company and moved into educational software.

The firm employs 12 people and is privately held. The firm's sales volume (estimated from the number of employees) would be around $1,000,000 and the firm has 142 software packages in the market, 73 of which are distinct.

The firm concentrates in producing software to build competency in basic living skills. These are products in "interest inventories," home economics, time management, budgeting, contracts, reasoning and logic, and special education. Their background in special education resulted from federal funding in the 1970's and their home economics and consumer education thrust came out of their filmstrip industry experiences. They actually left the filmstrip business in

1979 and changed over to software when a consultant was brought in who then became the president. Their markets primarily include middle schools, high schools, and jr. colleges (remedial software) in curricula including career education, libraries, adult education, and continuing education. They do not market toward the home market because their products are designed with schools in mind. They have done a lot of drill and practice software and also some tutoring software with real life simulation.

Their marketing channels partly reflect their historical position in the market. For the educational supplement industry such as filmstrips, a large group of independent, multi-line dealers grew up. Many of these dealers belong either to the ICIA (International Communication Industries Association) or SPA (Software Publishers Association). Some of these dealers have their own catalogues and list Early Bird's products. Early Bird maintains no sales people themselves and relies on 250 independent dealers to make sales contacts. One such dealer is Career Aids of California.

Another major marketing channel is their catalogue and they maintain their own mailing lists. They have a WATTS in (toll free 800 number) to encourage mail order sales. They have adopted a 30-day preview policy for schools and feel it works well. They know some schools have abused the policy and they will not send materials to those districts.

To aid their dealers they put out some demonstration disks with excerpts but many people want to see the actual package before buying it. They analyze the market quarterly and make adjustments in the marketing approach. They have followed the demand from "catalogue descriptions ... to ... demo disks ("cream show") ... to ... reviews ... to "door pounders" ... back to reviews ... back to demo disks ... etc."

In terms of style of leadership, they have a product development department that has been given a set of guidelines on areas and design considerations, and are encouraged to be "as innovative as possible."

They have no other product lines and consider their products to be extremely innovative and novel [From discussing their products this would appear correct.] They have developed their own text authoring system and are proud of the degree of educational sophistication that their developers have. For example they have a specially designed phonetic analyzer that permits a student to respond to a question with a sentence rather than "a,b,c,d ..." They do not license outside software.

They consider their market approaches to be innovative and were the first to provide a free back-up disk with their software. They have a policy of providing dealers with **free** programs so

they can demonstrate them without having to buy them. They pioneered the 30-day preview policy and they will send send a sales person to support a dealer at a trade show or convention. They have gone so far as to supply "boot support funds" to dealers and work to keep dealers knowledgeable.

The heart of their R&D is a small talented internal staff with classroom experience. They always have ideas and get them from reading the literature including medical journals, trade journals, and by attending trade shows and sitting in on classrooms. They have "three years of ideas right now." They use weekly meetings to sit down and discuss the process. The firm's management is not contributory to the innovations.

They use a product evaluation sheet to get feedback from schools and they rarely study the competition to decide on product. The dealer network is important for product development information and they haven't relied on licensing or joint ventures.

They have eliminated some older products and revised the better ones. Changes in computer technology have outmoded many of the older packages. They do not explicitly round out their product mix, but have targeted the area of job prepartion as an expanding interest in the schools. They always have to keep an eye on doing the products that maintain a profit margin.

Development costs are hard to keep down and their professional staff salaries continue to go up. The authoring system has been an important cost control tool and they definitely see themselves as a product leader.

The Education Market. Early Bird characterizes the education market in general as good but selective. Larger firms that have not been careful about the character of the market have learned their lesson and dropped out. The education market will always "take a back seat" to the business market and "always be a harder path." The hardest part of the business is that it is difficult to show a measurable productivity gain [*Intangibility*].

Their products are curricularly attuned and acceptance has been good. They have no problems with teacher or student acceptance. Regarding risk, one must stay "lean and mean" to survive and one must "pay attention to windows of buying." And software piracy is a medium concern — all of their software is copy protected with the free back-up copy.

They view the role of textbooks as significant and are working to aim their products more toward them. They see a tremendous problem in teachers being able to wade through a "4 foot high stack of direct mail" and decide what is good and bad. If things were keyed to texts it would be easier for them. [Note: this suggests a major function of keying to texts as a way to reduce

problems of search.]

In this business they occasionally feel disadvantaged to the larger firm but are glad to not have the bureaucratic problems of a larger firm. They don't really know how aware every teacher (say in home economics) is of their product. They mail to many teachers by name but not to every home economics teacher. They are struggling with issues of site licenses and other ways to work out deals with school systems.

In summary, they feel the market is over the hurdle of whether the computer will "take my job" and over the hurdle "I might break it if I touch it." We are on a plateau now where much drill & practice software is thrown into the drawer. Many teachers are holding out to see if the software is better next year. They are watching IBM's approach of marketing "the solution." IBM comes in state wide, e.g., in West Virginia and across the board and may become the norm of the 1990's.

Today's software is more sophisticated and educationally sound and it is more the buying side that is holding things back. The school budgets are too limited and there is not enough inservice training to help teachers learn to evaluate software. Teachers need to better know true criteria for judging software, be able to read reviews and get past advertising hype, and not be coerced by a dealer.

Learning Facilitator Inc. — Product Development Manager

Background and Innovation. The firm averages about 48 people and is supplemented by outside consultants and debugging staff. The sales volume is $2.1 million annually and they have over 230 software titles. The products are about 1/3rd drill and practice, 1/3rd tutorial (animationa and CAI), and 1/3rd simulation (such as a chemistry set or plant growth). The company is an incorporated partnership and currently has no divisions, though next year they will have a separate division for video software.

They market through extensive use of independent dealers such as Softcat and do considerable direct sales with direct mailing of their catalogue. Their leadership style is split between laissez faire and enlightened. They have a hands off policy for product development and a hands on policy for bring products to market.

The company had originally been in filmstrips and now accounts for 10% of sales. No further filmstrips are being developed. At first the software was highly integrated with the filmstrip line but now they are completely separate. They are just beginning to develop in the video - videodisc market. Many of their products are highly innovative [judging from the discussion and their catalogue this is probably correct].

Considerable innovative effort is directed toward developing product and also toward licensing of software from outside developers which accounts for 30-40% of their line. They are also changing to a "standard user interface" to make porting of software between different machines easier.

They have no marketing group, per se, and maintain contacts to follow trends and get ideas for developing software. Sometimes they do something totally different and some are spectacular successes and some are failures. Many product ideas come from the president who was originally a teacher [**user-innovator**]. There are many informal meetings in which possible projects are discussed and occasionally an idea is posted for reaction.

Beta test sites with selected teachers at schools are also an important outside source of ideas [Note: beta test refers to the second stage of field testing of a software product, the first stage of which is often not external to the firm]. They had one joint venture with a computer firm in England where their software was adapted for U.S. markets. One source of innovation is from the developers of outside products that they license.

About 50% of their current efforts is in revising existing products and they do target rounding out their product mix within specialty areas — e.g. school grade targets or missing subjects. They reduce development costs by having developed in-house routines and techniques. They see themselves as a product leader especially in social studies where no one else makes more in the market (for example their presidential election simulation).

The Education Market. Learning Facilitator sees the education market in general as lacking buying power and complex with so many school systems and review processes. One must learn "the ins and outs" of the market and in contrast to the consumer market it is not as competitive. The market becomes more profitable as one gets on lists and contacts and has repeat buyers. The market can be profitable when one has a unique niche.

The ability to raise capital has varied. Early it was favorable but with the causualties of the early 80's there were no loans in the period 1984-1986. The conditions have now improved somewhat.

Their products are not curriculum based and acceptance varies by state. Some states definitely consider their software "too general." They are willing to take some degree of risk in the market and have several large projects under way costing around $2 million. [Note: this is one of the largest levels of risk taking found in the industry.]

In terms of personnel, it is hard to get good authoring people for developing software. The

piracy problem is significant and it is important to educate people about the morality problem. Regarding whether old products are hard to replace with newer ones they find that abouut 40% will buy an upgrade if the price is a good deal and about 20-30% will buy one if the price is "reasonable." The lowest price software they can market is about $40.

Regarding economies of scale, they have seen IBM gear up several times in the past. IBM can throw money at a centralized theme but this is not a centralized market and so they are not concerned. Teachers tend to be fairly well informed about their products and there is considerable duplication of product in some areas such as math and some of the language arts.

Learning Facilitator has some concern for equity and has developed software to 1) help find missing children, and 2) donated software to a van to aid the disadvantaged.

In summary, the problem with the schools is they need to transcend computer literacy and learn to use tools in facilitating the learning process.

Early Out — Executive Manager of Educational Software Marketing (and others)

Background and Innovation. Early Out was the largest casuality in the home and school market of the early 1980's. Their withdrawal from the market was so complete that most of the respondents located for interviewing were now at other firms. In 1980 the total sales level of the firm was $3650 million and the firm had a total of 85,779 employees. The firm is integrated across a number areas including electronics, military systems, computer printers, microprocessors, and integrated circuits. Early Out's strategy was to make their profit primarily in the sale of video games for the home, where their computer was sold at discount or with rebates to penetrate the market. However, as the current director of university relations at Early Out commented, there was not much of a home market for computers. Wives didn't want to keep their recipes on the computer, husbands didn't want to do their finances on the computer, and the passion for video games came and went. Compared with competitive systems for the home market, the machine was too powerful and inherently too expensive to compete.

Early Out was aggressive about ensuring educational software for the school market. An enormous in-house effort was set up as well as many contracts and arrangements with 3rd party developers. A substantial contract was drawn up with Control Data to convert PLATO software to the Early Out microcomputer. Other contracts for software were with Scholastic, Addison-Wesley, Early Burned [code name – see interview below], Filmstrip Convert [code name - see interview below], and DLM. Other arrangements were made with CBS, Walt Disney Productions, and

Milton-Bradley. When the company withdrew production of their microcomputer they left the 3rd party developers in the lurch.

Internal development primarily focussed on languages for the machine (e.g. Basic, Pascal, Logo) and in a strong tech support for 3rd party developers. The Logo effort involved working directly with Seymour Papert and bringing the final development inside.

Early Out was a strong believer in the technology and the possibilities. They strived to make their product succeed with "fun, color, and high resolution graphics," and were "far ahead" of the rest of the market. They projected at least a billion dollar market and had a "get rich in the home market" drive. Their machine was out 2 years ahead of the Apple II and was "a better machine than the early Apple machine — it had better graphics (color) and a more powerful 16 bit architecture."

When it was decided that the home market couldn't support the effort there was no question about dropping the project completely. "No one can survive in the school market alone [for microcomputers] – there is not sufficient margin." "Even Apple never depended more than 25% on the school market for their sales."

Economics of the Market. In one attempt at promoting the school market, principals of Early Out attended a summer retreat of the Chief State School Officers. They proposed that the group go to the U.S. Congress and press for computer education in America in the range of $5 to 20 billion. Only 2 people in the room could comprehend that vision and one of them, Steve Jobs (formerly president of Apple Computer), went on to get Jerry Brown of California to initiate a sizeable California effort. Unfortunately for schools, it is a "small crummy market place."

The lack of leadership is a serious problem and we should do demonstrations like the New Schools Initiative of the late 1970's. The politics working against such efforts are unfortunate.

An industry like this needs sales to drive innovation. Some of the early innovations will not be as successful as the later ones. Does it make sense that schools have to bear the costs of the earlier, less sucessful developments just so they can eventually benefit from the better ones that can then come along? Can schools be counted on to do that?

Early Burned Inc. — V.P. of Marketing

One of the casualties with Early Out was Early Burned, a prominent firm in school textbooks. In 1980 Early Burned created an entire division separate from the textbook division to enter the area of electronic publishing. They made two mistakes, by making software for Early Out's microcomputer they were greatly wounded by Early Out's withdrawal, and, secondly, by making the division entirely separate from the textbook division they had no corp of support from

the firm when difficulties arose. By 1983 the division was completely shut down and the effect on the company was to make it exceedingly cautious about any further software developments. Only in the last two years has Early Burned been "cautiously innovative" and has a catalogue listing today of 23 products (or product sets, e.g. a math package consists of 22 diskettes).

Current sales of the entire firm is around $200 million while current sales of software is less than $1 million. While there are a total of 119 software packages listed in Bowker's database, many of those go back to the unsuccessful effort with Early Out and over seventy of those are now discontinued.

The firm, like many of the textbook publishing firms, had many strong growth years with strong profit margins. As a result the firm was merged in the late 1970's with a number of other successful firms in similar markets. For various reasons the firm was again sold this last year to Time, Inc. These developments, however, brought no changes to the running of Early Burned itself and its management. It has four major divisions — K-12 schools, colleges, international, and life long learning.

Like other textbook companies, Early Burned maintains full time salaried sales representatives. There are 160 assigned each to their own territory. The company's style is strictly a team approach with little room for entrepreneurship. They have been "very successful doing these by the book." There are "no stars" and they know "the system" works. Their current line of software is completely integrated with their textbook line (in contrast to the earlier division that "used to mock the textbook." There is the curriculum, then the textbook, then to go beyond the workbook, they have developed software. The teachers' edition of the textbook makes direct references to software.

Their innovative efforts are distributed 60% to R&D, nothing to licensing, 10% in production, and 30% in sales and marketing. In marketing they have developed a new program of site licensing, they have efforts with Apple Computer, and they have been active in "positioning" the sales force.

They are leary of new technologies such as CD-ROM and videodisc, given their prior experience and are mainly responsive to the existing market. Most of the ideas for products come from sales and marketing. There are no superstars and there is occasionally an idea from management. They have only one in-house programmer and concentrate on editorial design. Most of the software development is done outside under contract ("like many other firms do.")

They study their other competitors a lot and are in a "me too" type of business. There are the eight major players in textbooks, fairly constant, and others that come and go. Change is

incremental and they are mainly "pro-active." They do not operate their software division as a profit center and only 2 of the 8 textbook firms do — Southwestern Publishing and Hougton-Mifflin (TALMIS reports that even Hougton-Mifflin waffles on whether their software division is a profit center within the firm.) Software publishing is considered a "loss leader" — it helps maintain and promote textbook sales but could not sustain itself on its own.

For development ideas they consider computer shows of small benefit. They have licensed software from Mindscape and from Southwestern. They are updating textbooks and software all the time. The life cycle of a texbook is 3-6 years and they also have to keep software up to date for new machines. A well rounded product mix is a mainstay of a textbook company though some areas are more important than others.

Economics of the Market. The education market for software is one where the buyers keep demanding higher quality and are willing to pay less. For a while the educational market looked "bullish" but it has "become tougher and getting worse." It will "never be as profitable as the textbook market." Nonetheless, it is a "hot business" with high barriers to entry and high margins. [Note: most of the respondents indicated that the high transaction costs were a source of a market niche and lower competition, and in general not viewed as a problem to them.]

In terms of compatibility to curricula, the school "had better be using their texts" to match with the software. Their matching of software to textbooks gives them an edge in the market. Teachers are knowledgeable about their software only if the teacher is computer literate. It used to be thought that the software had to be "flashy" to get students' attention but less flashy software is still well received.

High risk projects are not undertaken. The typical investment is about 1 manyear and Early Burned cited TALMIS' estimate that the average amount invested in a software package is about $35,000 (confirmed by TALMIS for packages costing $50 or more, and $14,000 for packages costing less than $50.) Something like the Voyage of the Mimi for $3 million would not be undertaken. The most extravagant development they have seen was McGraw-Hill's new math series which had two outside developers and cost $1 million for the software portion. And then the series was not adopted in California [Note: consult discussion on state adoption policies].

Computer hardware manufacturers have not made things particularly easy for software developers. Working with Commodore machines is very difficult, Apple is the most cooperative, and IBM is somewhere in the middle. They are reasonably certain that IBM does not have the resources to make the software commitment and will need third party vendors.

Regarding copy protection, today schools will buy the first copy. The problem is "selling the next n copies. If they have 12 machines they buy 1.3 pieces." It is definitely necessary for publishers to do volume deals or for larger districts to arrange site licensing which makes the market the 100,000 school buildings rather than the number of computers.

It is hard to say how quickly educational software will "turnover." A text changes every 6-7 years. Then there has been something like Bank Street Writer that came out a good while ago which many people are still satisfied with even though there are now better products out. Teachers invest time in learning a piece of software and they are reluctant to throw that away. This makes the market more sensitive to teacher turnover which is much slower. The top selling computer titles haven't really changed much in the last three years.

In terms of judging education software for how it really contributes to learning, teachers still don't know what they are looking at or how to evaluate it. There has been all this research about the effectiveness of the computer, out of proportion to other vehicles of education. The value of the textbook, in contrast, is well understood. People just are not looking at "perceived value."

Lower priced, more limited focus software is not the textbook mentality. The orientation is to put things in a larger package. With some of the deals for lab packs and site licensing, some software is actually getting down around $5/copy.

In terms of economies of scale, they don't treat software as a profit center so are not concerned and don't feel disadvantaged. In terms of teachers, most are not current or capable of evaluating software. Transaction costs are very high already and as they require software to be more attuned to curriculum the transaction costs will continue to climb. It's the probem of getting a committee to decide in contrast to a single decision-maker in the business world.

Products are very duplicative in some areas including tools (like wordprocessing), drill & practice, etc. When packages are adapted to a particular text they become unique and less duplicative.

Regarding intergenerational legacy, they are convinced that the future of American education and its future citizenry is dependent on the new technology. The technology's main virtue is to help education one-on-one. Equity problems will still be left to dedicated people who "buck the system with the tool."

The most critical issues are teacher training and the crisis for funding. Perhaps we need another sputnick to give the country a kick or something like the highway fund. Also, we need more investment in the innovative $3-10 million software package or series.

Body Beautiful — President of the Firm

Background and Innovation. The code name Body Beautiful comes from the orientation of this small software firm to concentrate on software to learn anatomy, physiology, and biological feedback. The software has a high level of graphics and is intended for advanced high school and college markets.

They have thirteen software packages in the market and their annual sales is a modest $10,000. The main purpose of the company is to provide some professors at Northeast Missouri State with an opportunity to do electronic publishing. Thus the orientation is on education – not financial rewards. The president holds a full time associate professorship there and devotes 10% of his time to the firm. The president, with a Ph.D. in Physiology, is a sole owner and has operated the firm for seven years. They operate democratically and half the profits on any project are shared with the staff that developed it. Two undergraduate students are currently working on projects on a contigency basis. The students have done better financially than if they had been paid an hourly salary and also the commitment of the student is better. Another principal, a physician with the health center has recently moved to the West Coast.

Sales has been principally through an arrangement with Harper & Row. Harper & Row sales people demonstrate the software and Body Beautiful makes the shipments. QUE has also been a representative and duplicates and distributes their software. They advertise in technical journals when they can afford it out of the cash flow, they make themselves known at an annual biofeedback conference, and they mail catalogues to universities. A couple of other mail order arrangements have been with Carolina Scientific and HRM (Human Relations Media).

R&D funding has been the investment of 100's of hours of people's time. They make sure their software can run on the whole line of Apple computers the II+, IIe, IIe enhanced, and the IIgs, and also the compatibles including the Laser and the Franklin Ace.

Graphics are done by a medical illustrator and they invest considerable time in that. They work to keep the material as up to date as *Science* and probably 2 years ahead of any textbook. They look at this as true electronic print. They strive to have good features such as an online glossary, extensive multiple choice testing, and some reasoning. They give feedback to the student about right and wrong responses plus why the response is wrong. They would like to make the programs smarter such as providing more levels of difficulty in attune with the student but they are not sure the market would pay back the investment.

The leadership style is a hybrid. The president sets the agenda and goals but these are negotiable and input from the programmers makes the time-frame and specifics more realistic

[Note: since the programmers tend to be quite young, this style may be necessary because of the general inexperience of the programming staff.]

There is essentially one "work-horse" program that has been developed to do the software interactions [Note: this would be their own "authoring" language.] They listen carefully to customer comments and form new products to meet their interests. One of their goals is to help prepare students for graduate record examinations. In terms of novelty they have rebelled against the text oriented materials out there that were mainly "page turners." They realized that graphics were necessary in this field even if the graphics resolution of the machines were limiting. They have innovated to compact text files and are writing a new program to help combine text and graphics. In terms of the Apple they needed to overcome a rainbow color abberation and also how to compact pictures to the disk.

Their market orientation is mainly through Harper & Row. The president's teaching experiences are the main source of his ideas. He will check this with Harper & Row and then do the design. He looks at competitors mainly to see what is out there but sees little to follow or emulate. Most is too elementary compared to the level of presentation they are aiming at. In terms of the electronic publishing, the university gives no real weight to its value compared to peer reviewed articles. [Note: greater acceptance of this form of authoring would be a substantial way of encouraging these innovations but may not be forthcoming just as most forms of "inventing" are not encouraged by the peer review process.]

They are going back and revising some of the earlier programs to take advantage of 1) new knowledge and 2) new graphic capabilities. There is a 50 - 50 division between developing new product and enhancing the existing product. Production is all done in-house (packaging, labels, and disks) except for printing of materials. They create utilities to help save 15-20% of the time it takes to get a package developed. One utility looks for errors in text files that create problems and another permits "dumping" [printing] of screens. They don't feel they have penetrated enough of the market to be considered a "product leader."

Economics of the Market. They have seen the market for their products expanding as there have been better, low priced machines. The split between Apple and IBM computers is a complication. They view the profit potential in the educational area as lower than business but their rewards are in educating.

Their material parallels Harper & Rows' textbooks and this leads to strong curriculum acceptance. Their relation with H & R is through initial letter contact with potential partners.

Their market experiences are largely at the college level. Administrators tend to ignore educational software and librarians are very active. Colleagues have been positive but they might be biased to say that. Students don't need to know computers to be able to use the software, they can just switch on the machine and start.

Regarding risks they certainly wouldn't go out on a limb. Their cycle is about 6 months and their topics are fairly circumscribed by the boundaries of the field. They don't expect to compete with textbooks but rather add depth in places.

They do find it hard to find program developers that meets their expectations. They want someone reasonably bright, motivated, but not too hyper. They want to enjoy the process.

Regarding suppliers of computers, they are torn by the higher resolution of the newer machines and meeting the *installed based* [Note: this is a recurring problem throughout the software industry that so many of the existing machines in schools are old and their limited capabilities severely restrict software producers.] Software piracy is something they just rather not think about – they don't need the heartache. Their software is not copy protected and since they are more interested in seeing the software used than profits, copying is not a struggle. Their customers realize how quickly knowledge can change in the field and are quick to upgrade. They typically charge $5 to upgrade a $50 package of about 5 disks.

They are sure their software is a "good allocation of money" but many teachers are not expert to judge. The experience a student gets from software cannot be replicated by the textbook and can be of extraordinary value compared to the price. Smaller, lower priced programs could not be marketed. Larger firms have better access to programming resources, otherwise, their relation with H & R gives them large firm market support. Users of H & R textbooks are probably aware of their products. Their biofeedback programs are carried in catalogues with mailings of 100,000 but they would need large ads in journals to achieve brand recognition.

They reduce transaction costs by matching with H & R. They keep with H & R's terminology and their basic facts. There is an outer limit of acceptance of what is relevant to curricula. People are fairly short sighted about the ultimate value of educational software developments. In biofeedback, e.g., their products are often used to prepare for the Biofeedback Certification Institute of America.

They see equity considerations in terms of motivated and unmotivated students and feel the immediate feedback of the software helps overcome that.

In summary, inservice training of teachers should better acquaint them with 1) how software can be useful, 2) how to select it, and 3) what sources to look at. The lack of university

recognition as a form of publishing is a serious drawback. It is important that professional groups recognize excellence in the field.

Major Force Inc. — V.P. of Marketing

Background and Innovation. Major Force is one of the larger companies that develops only software – it does not sell textbooks. They are an innovative company with considerable brand recognition in the business. They employ 220 people and have about 125 software products on the market. They are a privately held company and their president has a background as a lawyer and in a filmstrip company. The firm is about 15 years old and began by developing filmstrips for health and guidance. The company is comprised of many former teachers and established a microcomputer division 5 years ago.

They are one of the firms that participated in the recent effort of California to encourage firms to take on riskier projects. Their assessment of that effort is useful. They were leery of the politics of it being an administered project. They felt as though they owed California a proposal but did not consider the California market enough to stand behind. They didn't want to hinge a major or important product on the effort and picked a project that was something they would develop but was of less importance than others. They did that because they didn't want to put something important into the vagaries of a government administered project. They want to set their own controls and timelines for "risk product." They are not a contract development house but rather a publisher and the combination of government control and their own controls are incompatible and their people are valuable resources they don't want to divert from their main style of business. [Note: it is interesting that they would propose something that they will do anyway – part of the purpose of the California grants was to encourage larger, riskier projects that would not be otherwise undertaken.

They market today only through direct mail catalogues and 1 sales person who convasses the top 20 schools. They used to work with the independent dealer network but cut that out altogether 1 1/2 years ago. They concentrate further efforts in hotline telephone support for customers.

Their R&D funding is aboout $1 million/yr and develop 30 new packages each year [Note: this is $33,000 per project or about what TALMIS reports for development costs of packages selling for more than $50.] They also engage in 50 conversions of existing software to other microcomputers (mainly IBM's). Their style of internal leadership is "participatory." Further, they maintain high levels of innovation by a novel organization structure. As their software business grew they were concerned about keeping a bureaucracy from imposing on the software

developers. They have established five development offices across the country, each around an existing person in each area. They are about equal in size and are small units which encourage innovation. Each unit has the one key person, about 3 programmers and up to 10 part-time staff. Each unit must seek internal approval for projects but are otherwise self directed. The rest of the firm carries out publishing, design of materials, and quality control. There is a fair amount of flexibility for the staff in general.

The company is engaged in three product areas: elementary print materials (low volume), filmstrips, and software. There is little to no integration among software developments and their other activities. In addition to software developments by their 5 development offices, they receive about half their products from outside authors. These sometimes involve joint efforts but more often are finished products. They insist that one of the development offices be the contact point for the outside author. They will hunt about the offices to find the right one. Very often that office will continue the relationship, e.g., working with Judah Schwartz and Educational Development Center. The outside developers are about 1/3rd university based, 1/3rd teachers, and 1/3rd other. Their software innovations are often novel and creative.

They judge the market by 1) their own intuition (former teaching experience by many of the staff), by 2) "facts", and 3) talking to people. They don't believe in surveys because people don't really have an image of what they want. The business is more a matter of they know what they want when they see it. They compare against competitors to be different and be better than them. One joint project has benefited them immensely. They teamed up with Koala and Henderson (of Kermit and the Muppets fame). When Koala had financially difficulties they inherited the relation with Henderson and a number of the projects benefit from the connection to the muppets. Statewide conventions are very imprtant to talk concepts and promote word-of-mouth.

When asked about the pervasiveness of MECC software, the response was mixed. They "got the industry going" and at times their foothold can be an unfair advantage. They have become a for-profit and are now on equal footing with other competitors (previously much of their development was funded by the state of Minnessota). Their policy of state and regional wide licensing is something that Major Force wouldn't do. There are some schools that are full of MECC software and some that are full of Major Force's.

One of their more important market innovations has been the policy of free updates for software. Recognizing the hassle of getting a $10 purchase order they have found this policy to be very popular. Products are almost never discontinued though they add on to some regularly. Only some earlier computer literacy programs have been discontinued. They pride themselves in

supporting the teacher and see training as the biggest cost to selling software. This policy of free updates and telephone consultation has greatly enhanced their recognition in the market. They definitely see themselves as "product leaders."

Economics of the Market. They consider the education market "good but difficult." One can get stability from brand recognition and they feel it is more secure than the home software market. It may not be as profitable as the business sector but they are growing comfortably and as much as they want. They were able to easily get bank financing for recent construction of a new building.

Their software is not directly oriented to curricula and it is very difficult to change it as a vendor. The best opportunities are when curricula is already in change such as the current move to view "writing as a process" in terms of rewriting and editing. Another area of curriculum change is the move to problem solving and this lends itself to educational software development.

Teacher awareness is at a level of: 15% are ahead of the rest, 60% are a little skeptical but open, and about 15% are impossible. [Note: compare the similarity of this perception to Rogers' model in the section on information networks.]

Major Force will take on a couple projects they consider higher risk and more innovative. These may range as high as $150-175K in cost. Some of their earlier problem solving software was considered high risk. Now a product for writing that requires an auxillary touch pad is considered risky and has thus far seen only some success.

In terms of personnel, they tend to grow when they find the right key people. It is a market that expands as one finds a key, innovative person to expand it. Suppliers of hardware "make life frantic" with changes that they have to adapt product to. They pose no constraint. Major Force actually views the presence of large memory machines as a threat since they have been so successful with the small memory machines. They are not comfortable with database or CD-ROM products that these machines make possible and they fear competition in these areas from someone more capable.

Curiously, Major Force has little concern about piracy at the school level. They copy protect software but did so mainly to prevent the dealers from making illegal copies. They feel school boards are doing a good job on policies regarding illegal copying and they don't think returns under preview are really ever copied. They attribute some of this to the goodwill they show their customers in the high level of customer support.

With their free update policy, Major Force has a sense of how often customers want an up-dated version of programs. Seventy percent of their customers request an up-date. [Note: this

compares to figures from 30-50% when a nominal charge is involved.]

Major Force views reasons software packages cannot be of more limited scope and lower cost as teacher related. It takes the teacher time to get to know the package, to learn it, and the time it takes to fit in into his or her own curriculum. Of course as programs become more transparent and the intracies are less, teachers will find this less troubling. They are generally amazed how many teachers don't know about educational software.

Major Force does not see economies of scale in the business. Smaller, innovative firms that are quick and know their market are able to adapt and succeed. The transaction costs are clearly seen as barriers to entry and creating a sense of "our market." Like others in the business, they feel knowing the ins and outs of the business creates opportunities and lowers competition.

While it may appear that software is duplicative, each has its own characteristics and features. This increases consumer choices.

Street Vendor Co. — President of the Firm

Background and Innovation. For a 1 1/2 person firm the annual sales volume of $250,000 and the number of software packages — 80, is surprisingly high. The president had had considerable previous computer experience with IBM and EDS (before it was bought by General Motors). At EDS he was technical manager of a K-12 "full blown" curriculum effort until EDS decided to drop all microcomputer developments in late 1979. Interested in having product of his own and sense of being of service, he began Street Vendor in 1980.

Many of the programs come from teachers where the product is already written. Some come from ideas he has and contracts for coding, and a few he codes himself. Seventy of his packages are for the Apple II and ten more are for the IBM PC. He is actively converting more Apple II programs for the PC. The programs run a wide variety from alphabet skills, country statistics, and tutorial up to college level. Some IBM programs that they have sold include one on library skills and another on word vocabulary for SAT prepartion.

He depends on both direct mail sales using a catalogue mailing and requests for catalogues from magazine provided requests (reader information cards) that account for 15% of sales. Seventy percent of sales come from using nationwide dealers including Softcat and Banana. Another 15% comes from an educational catalogue company where they fill orders that are forwarded.

R&D consists of some of his own time, paying an outside programmer (only 1 in 10 of the products), and doing documentation and tidying up or advising of author submitted materials.

After all discounts and freight, the outside authors receive 15% of the sales. The half time person fills orders and takes care of invoices.

With outside authors he uses no imposed hard deadlines. Usually outside authors are interested in getting the royalties and so are self-motivated to respond quickly. The degree of novelty of the product is a reflection of what is submitted. Many of the teacher submitted pieces are written in Basic and not of high level of interactivity.

He works to make dealer sales easier by providing "focus samples" where he groups similar programs in a subject on a disk which shows the name and address of the dealer providing the preview. He sells these preview focus samples for $3 to dealers to "cut the noise." Before they would show bits and pieces of programs on "demo" disks but these were not well enough suited to review and preview. They do special mailings to dealers every 3-4 months with some form of promotion to keep the product interest up.

Most of the ideas for products come from the authors that submit programs for publication. He contributes some ideas. He doesn't pay much attention to competitors and doesn't use conventions to learn or promote. He mainly advertises in magazines like *Learning Instructor* and other computer oriented publications. He seldom revises product and will just drop one that is unsuccessful.

Economics of the Market. The market is reasonably good but not as good as a few years ago. If he were looking for more profit he wold go into business market. He is less interested in profit than in having his own firm.

His products are not matched to curricula and so curricula are a constraint. Teachers and students are seen as receptive. If the product "doesn't work" this is more the fault of the product than the teacher or student. He has no time to think about anything too big. If he makes a big mistake he is out. Some of his preview disks are copy protected. He knows there is a piracy problem but he doesn't know how big it is. There is nothing he can really do so he ignores the problem.

He would like to be in an arrangement with a textbook publisher so he could coordinate product more with textbooks.

The lowest priced software is $24.95 up from $19.95 a while ago. He is not concerned about larger firms and feels there are so many advantages to having no red tape and his own business that outweighs any problems.

Teachers need to be at least computer literate to buy his products and he sees the problem of duplicative programs in the market posing a lot of problem to teachers in deciding among choices.

Brand name will become important as a way of sorting this out.

Street Vendor is particularly upset to have to compete against efforts that have been subsidized like MECC, particularly when MECC was nonprofit and state supported and that gave them an unfair advantage in the market.

Science Ed. Inc. -- President of the Firm

Background and Innovation. The company specializes in science education and has 120 software packages on the market. Annual sales are $500,000 and there are four employees. Packages are drill & practice or tutorials. They have no simulations and some games. They have no separate marketing person. The president has a Ph.D. in science education and was chairman of a high school science department. He does most of the development of products.

Sales are attained mainly by mailings to schols and advertisements in *Science Teacher* and computer magazines [Note: advertising costs in magazines can be a very large cost for a small firm, often running in the $100,000's for monthly advertisements in a few magazines.] He maintains a mailing list of every science chairperson in the country in junior high and high schools. They have done mailings to one in six of science teachers. Thirty to forty percent of their sales come from listings in scientific supply catalogues such as by Fisher Scientific and Carolina Biological.

R&D consists of his time and a couple of projects with outside teachers on a royalty basis. The style of the firm is relaxed but with goals and timeframes. They hire some summer programmers on salary.

They feel their products are fairly innovative. They branch for weaknesses to additional information and to basic knowledge on concepts. They provide utilities for teachers including banks of questions. Their tutorials find where the student is in terms of knowledge and then respond to that. They also provide grade management software for teachers. About 70% of their effort goes into product development and 30% into production.

Sources of innovation are the president's experience in high school [Note: another user-innovator]. The president also talks to teachers about ideas and then develops them. Perhaps half of the ideas come from the outside. Some but few ideas come from the scientific supply companies and competitors. A good number come from teacher contacts. Conventions are very important and others come from reading journals and informal conversation. Regarding joint ventures, they would like to joint venture with a university.

The product mix is already fairly well rounded and there is considerable activity in updating and responding to people's comments about existing software. The company sees itself somewhat as a product leader in the one area.

Economics of the Market. Advertising costs are high for a market that is fairly good. Education software will have lower profits because the prices need to be lower to the school market. Nonetheless, start-up and overhead costs are low. The company would enjoy working with government subsidy, e.g., in cooperation with a larger school district and a team of teachers to help produce software for them.

They match their products to the college bound high school student and school curricula so acceptance is high. Students are divided into two categories: the motivated student will always succeed with their products; the unmotivated student will give up and play with the machine no matter how entertaining one makes it. They have some ideas for product they consider too risky due to the school market and have to be conservative. They copy protect only the software for teachers such as their gradebook programs. They permit copying of software on site without extra charge. Their software prices range from $28 to $250 for a set of chemistry programs.

Their sense of older products is that few people order updates and are satisfied with the older products. Regarding software perceived value, it varies across schools – some spend too much and others don't even know how to use the software. Smaller packages of lower costs cannot meet the costs of advertising. Regarding larger firms, yes they feel disadvantaged to the budgets they can spend on convention booths, prizes, and flashy (and sometimes misleading) advertising. These people can spend more on development but that may even be a disadvantage to them.

Transaction costs are high and they are currently taking six popular texts and looking for common threads. They are studying, for example, the Regent Syllabus of New York State. They see a lot of duplication of software in some areas such as the grade book package and much less in the area of earth science.

Good and Plenty Inc. — Vice President of Marketing

Background and Innovation. This medium sized firm (for the software industry) employs 15-25 people, has annual sales of $3 million, and lists 1800 programs from preschool to SAT preparation across all subjects. The president, previously with AT&T, has a background in education and law, and concentrates on creative relationships and sales. This is a high energy, long hours firm and many of the employees are single. The company is comprised of a half dozen of separate entities some of which are located in-house. Many of the earlier products came from these

entities but today 75% of products come from the inside.

Marketing channels include use of independent sales represenatives varying by state who are well educated and often retired principals and school contacts. They were the first in 1980 to have their own catalogue and they maintain their own mailing lists. Until 1983 they represented small author-publishers. At the beginning the business was largely a cottage industry for which they catalogued products. They prefer not working with the national independent deals like Softcat.

The firm is run like academia – like a top notch school. Beyond software they have products in educational video and workbooks especially for the classics. Only occasionally do they integrate their literary video products with their software. Basically teachers who use video are not the same ones that use software. Ideas are predominantly from teachers though occasionally some interesting technology advance such as something in reasoning can lead to a product. They look very little at competitors and conventions used to be important but not anymore. They will still have someone go to look around. Their representatives will present at state shows.

The staff concentrates on products and the president works on license arrangements, etc. Considerable effort goes into editing of products and they do not intentionally round out their product mix but rather follow the market. They see themselves as leaders in the "finest secondary school software for IBM computers."

Economics of the Market. The market is selective. Schools budget more for hardware than than do for software and the software budget is too small. This is a serious concern. The educational business is "nothing like business markets." There are too many cutbacks in school budgets and schools are always pressing for a break in prices, for example, through lab packs (a lower price for a set of computers in a computer lab.) They see Title I and II funds as important particularly at the last minute when schools must spend them or lose them.

There is no teacher resistance and many are saying "help me." It is the odd teacher who won't work with a computer and many feel stymied for lack of funds. Also, the educational market just can't pay for large software development projects. One could never get the money back.

Good editorial people are hard to find and the firm environment is very demanding.

Regarding IBM's entry they are reminded opf CBS's large pitch to the market that hasn't succeeded.

Software piracy is now less of an issue that everything is copy protected. At the beginning it was an enormous problem. They permit schools to purchase a back-up for an additonal $10.

Products are still quite different and each has its own character. One can sell over what is out there — it is like "an particular author you like." No package can sell for less than $24.95 and

most have to sell for more. The only difference the larger publishers have is their presentations are "glossier." Quality is not linked with bigness in this industry. They emphasize service and 30-day preview to help teachers know about their products and have an 800 customer number.

Transaction costs are manageable except for New York City where they have experienced "massive red tape."

In general they feel the lack of school funds is "slighting the educational system." [Note: unlike a business market where this would be a self-serving remark, this comment reflects a genuine concern about the quality of education.]

Filmstrip Convert Inc. — Vice President of Marketing

Background and Innovation. This firm is one of the larger and more prominent education supplementary materials firms in the education market. It has been in the supplemental business for 27 years. Total sales across all divisions is $25,000,000 and there are 60 people, 15-18 of whom are involved in the software business. Software sales are within the range of $1 to $5 million annually and they currently have 40 software packages. It is a very traditional company and operates their software activities as their own profit center, with business plans, budgets, etc. that are continually monitored. Within the confines of those business plans there is generally freedom of action to meet those plans. The firm is privately held and has three divisions: computer products, supplemental books, and a reading division of 4 color children's books.

Up to a couple of years ago they used an independent dealer network of 350 dealers, 100 of which sold the majority of the products. Today they have cut back to fewer than 70 dealers and have increased their direct mail efforts [Note: this appears to be a trend in the industry.] Some of the dealers are members of ICIA or the National School Supply and Equipment Association.

The software products are minimally integrated with the other lines though they would like to do more. The internal structure of the firm makes harmony between the divisions difficult. The novelty of the products depends on the application. They have drill & practice in areas like math with pre and post testing, diagnostics, and help. In general, the products are written embodying good practice in educational method and techniques.

They develop products both in-house and with outside authors. In the case of a math series they used an outside author to establish basic content and then coded and finished the product in-house.

They are very oriented to the market through their field staff of educators. They will perform written survey samples and competitive product analyses. No product direction comes from upper

management though they choose the general direction and bless or condemn product ideas. They occasionally analyze the activities of competitors.

They have on occasion worked in a joint venture with a publishing company and it has been reasonably successful. They rarely license product from others and do find conventions worthwhile. A large amount of effort is going into rounding out their product mix. Internally, they strive to improve the efficiency of their team approach to product where an editor is the "group commander." For example, rather than assign a project and review it after a while they have changed over to more frequent iterations. They strive to be first in products and take pride in their work.

Economics of the Market. They are much more negative today about the market than they were three years ago. They see the market as profitable for a limited number of companies. Education markets are definitely least attractive of markets in general from a profit standpoint.

Statistics they have seen indicate that software outlays are only 8-12% that of hardware and this is a serious problem. They try not to be trendy and agonized over whether to enter the computer literacy phase and avoided it. At best, 20-25% of the teachers are interested in using computers in the classroom and they see this topping out. They consider teacher acceptance the "greatest hurdle." Students can always be counted on to like the products.

High risk projects are avoided. "Very much way of life." They might find personnel shortages if the market were stronger but not as it is. Now that the piracy problem has been "aired" there is much less of a problem and they expect that less than 10% copying goes on today. They see software as having more longevity in the market than textbooks and less than 5% have traded in software for upgrades. This could be a serious problem in supporting the industry.

Teachers and schools have a hard time with the "perceived value" of the software product. Often it is compared with the cost of a blank diskette and they "feel ripped off." Software is not being venerated like textbooks and yet good software outperforms the textbook and helps reduce the demand on teachers. The lack of value perception has "destroyed this market." Teachers demand services and yet they will buy software from the lowest discounted bidder. Regarding how informed teachers are about their products, "teachers are as informed as they want to be." There is the 80-20 rule — only 20% are going to be interested.

Filmstrip Convert feels very threatened by larger firms like IBM and see "window of opportunity limited at best." There will always be niches for smaller firms in areas that are less attractive. The transaction costs are very significant. Each local entity has its own operating procedures and rules which make marketing very dfficult.

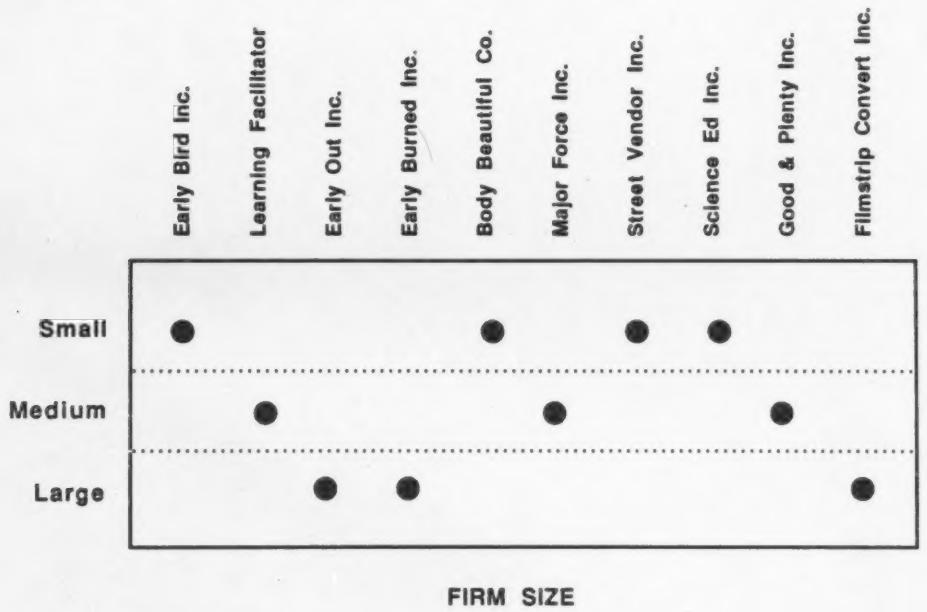
They see a lot of duplicative product in the market place — "unbelievable overlap." They see a lack of "full blown" curriculum packages. Further, the market just doesn't look at investment in the software area as an investment for the future.

In terms of equity, actually many packages have been designed to help the disadvantaged — to aid in remedial learning. Much of this came even before the title funds. Computers are "great remediators and are effective here."

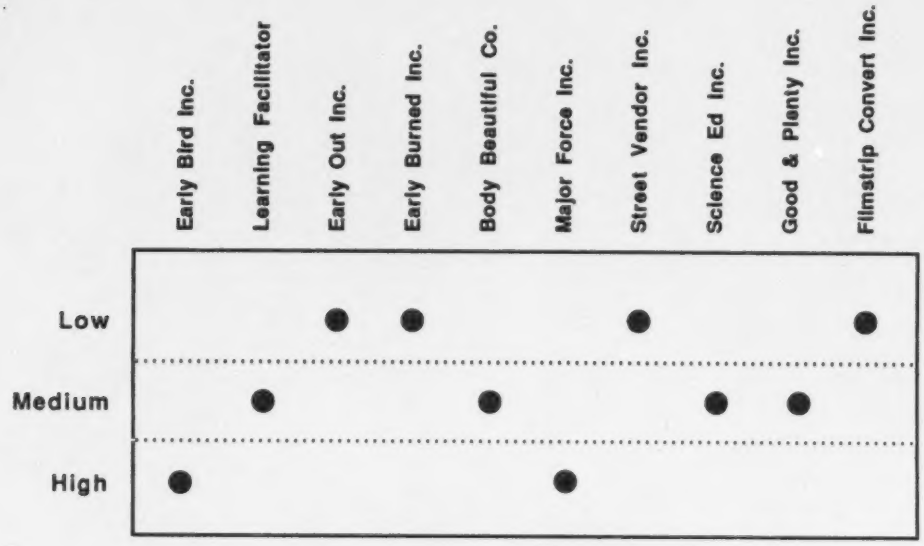
Comparisons Among the Ten Firms

Five tables have been constructed to compare and contrast the firm responses. *Firm Survey Results Part I* shows the responses to questions on Innovation Barriers from survey question II-31 to II-41 (see the appendices for a copy of the complete questionnaire) and *Firm Survey Results Part II* shows the responses to questions on Innovation Barriers from survey question II-32 to II-52.

In addition, there are three further tabulations that aid in comparing the firms. The following table shows a breakout of firm by size:

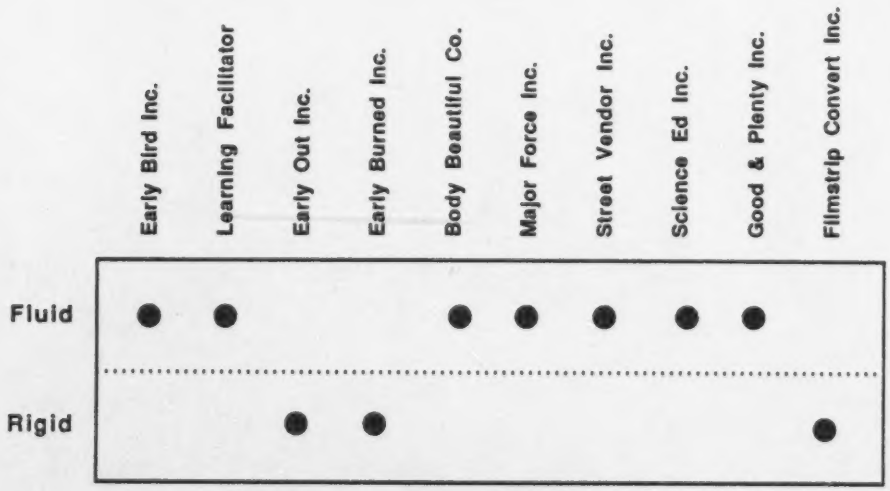


To aid in comparing the firms by novelty of their innovations, the following table will be useful:



FIRM NOVELTY (of Innovations)

And to compare against the general character of the firm:



FIRM CHARACTER

Test of the Proposed Hypotheses

Statistical Background. With the four tables of results the originally proposed hypotheses can be examined to better understand the innovative character of firms in educational software. Since the sample size is small, only large tendencies will be noticeable and at fairly low confidence levels. Nonetheless, even weakly indicated associations can be useful to supplement one's own knowledge of the world in a Bayesian fashion as long as one realizes that 1) even if the observed tendency supports a hypothesis there is a "fair chance" the effect may not actually exist in the population as a whole, and 2) even if the tendency appears to rule out a hypothesis there is a "fair chance" that the hypothesized effect may still exist in the population as a whole. We will employ the non-parametric test of association know as the Chi-square test. This is suitable when data appears in tables such as the ones above and there is no quantified relation indicated by the measures used — i.e. high, medium and low are meaningful as categories but not quantities. The "p value" gives the probability that the values in the table would occur by chance. The chi-square provides a measure of association – the higher the chi-square the stronger the association between the two factors being considered. With these nitty gritty qualifications of the limitations of sampling and probability theory out of the way, let us turn to some possible conclusions.

Results of the Analyses of Ten Firms in Educational Software

1. *The more rigid the firm, the less novel will be the innovations*

This statement follows directly from the Abernathy-Utterback conception of the firm and stages of innovation. The table supports this statement and shows a fair association between the character of the firm and its novelty:

NOVELTY (med-high / low) \ CHARACTER	fluid	rigid
med-high	6	0
low	1	3

This is supported nearly at the 95% confidence level (p value of .06 and a chi-square of 3.4)

2. *The more rigid the firm, the higher the ratio of process to product innovations*

This statement follows again from the Abernathy-Utterback model of stages of innovation within the firm. It was not necessary to formally test this statement since, for the most part, the entire educational software industry is sufficiently young that there is little concentrated effort on process innovation – that is, concentrating on manufacturing and distributing software products at lower cost. At this point in the life-cycle of the industry, the costs associated with copying disks and printing guides are small compared with product development, and marketing and sales costs are not the main attention of innovations. Inerestingly, marketing and sales are areas of innovation in a different way – in the form of site licenses, preview copies, and other license arrangements. However, these are **price reducing** innovations, not cost reducing innovations. In fact, the added transaction cost requirements of these arrangements serve to **increase costs**. So while they might be termed process innovations, they do not match the sense of a process innovation as described in the model of innovation cycles.

3. *The more rigid the firm, the greater the percentage of product innovations*

As in the second statement, the industry is so predominantly in a product innovation stage that this comparison is not meaningful at this time.

4. *The larger the firm, the more rigid the firm*

In terms of the firm innovation-life-cyle model, firms become larger and become more rigid. The following table shows this statement is strongly supported:

FIRM SIZE	CHARACTER: fluid	CHARACTER: rigid
large	0	3
sm.-med.	7	0

The level of confidence is better than 98.8% (the p value is .0015 and the chi-square is 9.9)

5. *The larger the firm, the less concern will be expressed on appropriability*

The hypothesis was posed on the assumption that fragile small firms would be very concerned about every dollar while larger firms could take piracy losses in stride. The following table suggests that large and small firms are equally not highly concerned about copying. Part of the reason for this is the general success of copy protection for software and the growing recognition in schools to not copy software. Another reason is that some of the smaller firms were mainly "self-patrons" – they mainly wanted their software to be used – and copying, while undercutting profits, at least met this goal.

PIRACY CONCERN	FIRM SIZE: sm.-med.	FIRM SIZE: large
high	1	0
low-med	6	3

The values in the table have little correlation (the p value is .49 and the chi-square is .47).

6. *The more novel the firm, the more concern will be expressed for externalities*

This statement was based on the assumption that the smaller, more novel firm would have a greater vision about the true value of their products in society and would find the school market undervaluing their products.

In reverse, however, it was the less novel, larger firm that saw this relation. To appreciate the relationship between educational software and social wellbeing, the respondent needed considerable experience and wisdom (and age). These people tended not to be associated with firms that produce more novel products.

NOVELTY \ EXTERN. CONCERN	low	med.-high
med-high	5	1
low	1	3

If a hypothesis had been proposed to mirror the above explanation, the hypothesis would be supported almost at the 95% confidence level (the p value is .065 and the chi-square is 3.4).

7. *Indivisibilities will not be of high awareness for any type of firm*

This statement was so much true that no respondent could think in terms of it from their vantage point from within the firm. Remember that we are talking about market failure due to the buyer not being able to purchase **just** the information or software capability that he or she needs. From the vantage point of the firm, their only concern is the flip side of this — the difficulty in marketing smaller pieces of software. While this is an important concern – one that argues against whether indivisibilities can be solved due to high marketing costs for very narrowly oriented software – this was not the economic concern that this survey attempted to elicit.

INDIVIS. CONCERN	low	med.-high
	10	0

8. *Publishers will recognize their economies of scale and scope.*

This statement cannot be tested since only one of the ten firms was also a textbook publisher.

EC.ofSC. CONCERN	PUBLISHER yes	PUBLISHER no
med.-high	0	3
low	1	6

The values in the table have little correlation (the p value is .49 and the chi-square is .47).

9. *Smaller firms will feel disadvantaged in terms of economies of scale and scope*

This statement is not supported. The discussions reveal why. Many of the smaller firms are unperturbed about larger firms because they see no economies of scale or scope in being able to develop and sell in the educational market. In fact, many of the smaller firms see bigness as squelching innovation and being a hindrance.

EC.ofSC. CONCERN	FIRM SIZE sm.-med.	FIRM SIZE large
med.-high	2	1
low	5	2

The values in the table have almost no correlation (the p value is .88 and the chi-square is .02).

10. *Risks will be of equal awareness but of greater concern to firms with less horizontal integration*

The assumption here was that firms with a broader base of business would be less concerned about risks because they did not "have all their eggs in one basket." The subject of risk was of high awareness to **all** firms and so the first part of the statement is substantially supported. However, there was no support for the second part of the statement, mainly because of the very high level of risk concern throughout the industry no matter what size or how well integrated the firm was.

HORZ. INTEGRATION	RISK CONCERN: high	RISK CONCERN: med.-low
yes	3	1
no	5	1

The values in the table have almost no correlation (the p value is .74 and the chi-square is .10).

11. *Firms with more novel innovations will be more concerned about conveying information about their product*

The assumption behind this statement was that firms with more novel innovations would have a more difficult time conveying the sense of their products to teachers and would, therefore, be more concerned about teacher awareness. Like the above statement about risk, however, the level of concern about teacher awareness is **so generally high regardless of novelty**, there is little way of confirming the hypothesis with the survey data.

NOVELTY	TEACH. AWARE. CONC.: med	TEACH. AWARE. CONC.: high
med-high	1	5
low	1	3

The values in the table have almost no correlation (the p value is .74 and the chi-square is .10).

Summary of the Analysis of 10 Firms. Both expected and unexpected results were found. Hypotheses built around the general nature of innovation and characteristics of the firm were generally supported. In other cases, some assumptions were substantiated, while others were found to be faulty once the actual nature of the industry was uncovered. The results, for example, on the externality question, though understandable in hindsight, were quite unexpected and revealing. A few of the hypotheses could not be adequately tested because of the sample size. In particular, the last few on teacher awareness and risk were not testable because both areas had high levels of concern across all firms, regardless of firm differences.

Summary of Overall Results on the Case-Study of 10 Educational Software Firms

Background and Innovation.

The firms ranged in size from 1 1/2 persons to 85,779 persons and from sales of $10,000 to $3650 million. However, removing the one very large firm which was unsuccessful, Early Out, the second largest firm, Early Burned (a textbook publisher), is a $200 million dollar firm with an estimated 2400 employees. Nonetheless, less than $1,000,000 of their sales comes from software. This leaves the largest firm in the survey based on educational software sales, Major Force, with 220 employees and an estimated annual sales of $25 million.

In comparison with major U.S. industry, the firms in the educational software business are almost immaterially small. The total annual sales of all 750 firms (Bowker) in educational software is estimated to be between $150 million and $220 million (TALMIS) and the top 25 firms account for about 65% of all sales. Thus the average size of the top 25 firms is $4 million in annual sales or about 35 people. The entire industry employs only about 1350 people. This places the average number of people working on educational software per firm at 1 1/2.

Comparing the total industry of $150 million with the annual budget of all elementary and secondary schools (not including schools of higher education that purchase some of these products) of $159,300 million (*Statistical Abstract of the United States, 1987*) the annual sales of educational software amounts to only .094% of the school budget or $1 in $1062. With 43,977,000 students this amounts to an annual expenditure of $2.90 per student. This is literally a "drop in the bucket." In contrast, Paul Strassman in *Information Payoff* estimates that business firms spend an average of $11,000 per administrator/professional in the first year (prorated hardware, software, and training) for the use of information technology.

The trend in the market is to move away from a direct sales force such as independent dealers to the use of direct-mail catalogues. Some firms have cut back on their use of indendent dealers

while others have eliminated them altogether. Only the textbook company maintains a sizeable salaried sales force.

Some of the smaller firms have a very relaxed type of management and enjoy the niche they have. Some others are very academically oriented with strong control from editors. A few others are very traditional with product teams and no "stars." Most of the firms only produce educational software. A few of the firms are "supplementary materials" firms and have moved from filmstrips to software, either cutting back in filmstrips or dropping filmstrips altogether. Some of the firms have other divisions and most of the time the software efforts are independent of these. The exception is Early Burned where their experience with a wholly independent division turned so sour that they insist on full integration with the rest of the firm's products.

Of the ten firms, 2 had a high degree of novelty, 4 had a medium degree of novelty, and the other 4 had a low level of novelty in their innovations. As shown above, this corresponds with firm size where the three largest firms had the lowest degree of novelty. The character of the firm also corresponded to firm size where again the three largest firms were also the three firms classified as rigid.

The implications of this is that the smaller firm turns out more creative, novel innovations and an industry with many small firms is good for the advancement of educational software. This reason alone may explain why the concentration of the industry is so low [Note: the economic term *concentration* refers to how much an industry is dominated by large companies.]

It was difficult to pin down R&D expenditures. Unlike large firms that explicitly budget for such an item, the small firms tend to lump the expenditure in with everything else. When a firm like Leading Force could provide a concise number, $33,000 per project over 50 projects a year, it corresponded almost exactly with a figure from TALMIS of $35,000 for software package development when the package price was over $50.

The sources of innovation were varied but there were three distinct modes. First, a major mode was the user-innovator — a company populated with teachers/educators with teaching experience. For example, in the case of Science Ed, the president was a former head of a high school science department. In Major Force many of the employees are ex-teachers and maintain small development offices to encourage innovation. These companies have a sense of what innovations would be useful because they can put themselves back in the place of a teacher using the product.

A second source is acquisition or hiring teacher/software authors under royalty. Street Vendor has built up a large assortment of packages through arrangements with outside authors.

Good & Plenty owes much of their earlier software to outside cottage industry activities for which they became a publisher. Early Out contracted out PLATO software conversion and with educational software publishers. Major force coordinates outside authors through one of their 5 development offices.

A third source is through a strong market relation via the dealers, sales force, or direct teacher contact. Filmstrip Convert and Early Burned both maintain strong sales force contacts. And major force prides itself on close contact with teachers via their 800 number and their policy of free updates.

Professional journals, computer journals, national educational computer shows, national and regional professional conventions, and state computer shows are also all important sources of innovations as well as providing marketing contact. Hardware suppliers were never cited as sources of innovations and no other supplier of, for example, software development tools was cited as a source of innovation for educational software. About half the firms say they look seriously at competitors' products and only one said they imitated other's products. Joint ventures were tried only on occasion and usually with some success.

.. Firms today are spending about half their development efforts on new products and half in updating older products. All of them cite the added burden of keeping up with changes in hardware. About half the companies intentionally work to round out their product mix while the other half either specialize or "follow the market." Most of them view themselves as product leaders in the market. Only a few could cite important organizational changes made to improve the way software products are managed and developed.

Economics of the Market

Introduction. *Firm Survey Results: Part I and II* show at a glance the results of the questions pertaining to economics of the market. Questions near the beginning of this section are typical of "barrier to innovation" questions in previous surveys in firm innovation. Unlike those surveys, however, the questions were made to mirror all of the identified forms of market failure. This was destined to produce low response rates in some areas simply because some forms of market failure are not apparent or of concern to firms.

The discussion in this report on the General Framework on Markets, Nonprofits, Patrons, and Policy divides market failure forms into two main categories: those apparent to firms and those not. In addition, and as a result of performing the case studies, those market failures apparent to firms are also subdivided into those that are of the same concern as society and those that are of a

different concern than society.

A few illustrations will make this clearer. Both society and firms are concerned about software piracy for similar reasons — piracy leads to the production of less software because there is less return to the producer. This leads to less innovation for society and less profits and business for the firms. For the most part society and firms are allied on this issue. (They aren't entirely because society always benefits from pirated copies while firms only sometimes benefit from pirating of copies, e.g., John Andelin has cited possible benefits to firms such as Lotus from pirated copies that increased buying interest within the market [OTA Workshop on Educational Technology, Aug. 6, 1987]. Because of the parallel interest, in general, the perception of the firm on piracy (appropriability) relates directly to the issue of market failure and societal welfare.

In contrast, the area of transaction costs is often not viewed by society and firms the same way, and thus responses about concern on part of the firms is not as relevant to understanding market failure due to transaction costs. The difference here lies in that while transaction costs are costs that society must bear, they represent haven for firms. In numerous discussions, firms cited having to know the "ins and outs" of the educational market as helping reduce competition and provide stability of sales. So, are firms concerned about transaction costs? Well, some who are less aware or less outspoken about the barriers to entry it provides will talk at great length about the problems of dealing with so many schools and committees and boards, etc. Others will calmly look at it as something that, once you've mastered, is a bit of a sheltered bay in a storm.

Thus the responses that show concern for transaction costs are quite varied, not because firms differ on how high the transaction costs are (they all agree that they are quite high) but their concern varies depending on how they view it. With this sort of difference in viewpoint in mind, we can proceed to look at some of the other responses.

Education Market. The education market for textbooks is distinctly different than the market for educational software. Goldstein [1979] provides one of the most comprehensive reviews of both markets to date. The eight largest companies account for over 50% of all textbooks and the 20 largest account for 79%. Goldstein cites an industry survey by D. Quirk that claims there "are distinct economies of scale in the educational materials industry ... Selling textbooks and other materials requires a national marketing effort, involving some combination of direct selling, direct mail and space advertising." Further barriers to entry are imposed by state adoption systems [see for example the discussion by the Texas State Legislature, 1984]. The ability of the major textbook firms to produce consistly good profits have made them targets of considerable merger and takeover activity. Recent acquisitions include Scott Foresman by Time, Inc., Prentice Hall by

Gulf and Western, and a recent attempt by British Printing and Communication Corporation to make a hostile takeover of Harcount Brace Jovanovich. In 1980 was the formation of SFN companies out of the merger of William Morris, Silver Burdett, South-western Publishing, and Scott, Foresman. Earlier mergers included IBM's purchase in 1969 of Science Research Associates, RCA's 1966 acquisition of Random House, CBS's merger with Holt, Rinehart and Winston in 1967, and Xerox's 1962 merger with Ginn and Company. Many of these actitivities were prior to when acquisitions became "fashionable." They often occured either to take advantage of economies of scales in marketing or because the profits of some of the firms were so high and consistent they were good "cash cows." Williamson [1979], president of Silver Burdett, defended the industry in a major conference convened by the Library of Congress on *The Textbook in American Society.* He stated that the industry was 1) the only highly competitive industry whose prime market is governmental agencies [implicitly contrasting with the defense industry], 2) textbook purchases constitute .75% of school expenditures ($700 million), 3) and, most interestingly, "after-tax profit of el-hi publishers as a group is, in many years, about equal to the interest the average depositor gets on his or her savings account."

Profits. Most of the respondents stated that profits were low in educational software when compared with other software businesses and business in general. This was mainly attributed to very small school budgets and the difficulty to show how effective software really is in achieving learning.

Capital and Financing. Almost all the companies financed developments out of cash flow and thus access top capital and financing was not of much importance.

Interest in Subsidies. Only one of the firms expressed interest in working with government funds in a joint project with a school system. Others expressed no interest at all. Major Force provided a detailed reaction to the State of California's subsidy of firms (detailed above) which mainly said they wanted to do their own development on their own timeframe and with their own controls. They were not tempted to propose something they wouldn't already do themselves.

Curricula, Teacher, and Student Acceptance. Curricula was a hindrance the more the firm created general tools and problem solving software that did not match against a textbook or standard course material. A number of firms matched their software to textbooks either as a textbook publisher, by teaming up with a textbook publisher, or studying major textbooks and designing software to be more compatible.

If a teacher was "computer literate" there was no problem with teacher acceptance. Their main problem is how few teachers are really comfortable with the technology. Students are not an issue at all, either because the firm sees the teacher as the make-or-break link, or because students are generally keen on computers.

Risk and Uncertainty. Firms were unanimous about the problems of taking on projects that are too costly and uncertain. Very few companies are willing to risk much more than $200,000 on a big project and the example cited of McGraw-Hill's investment of $1,000,000 in a new math series (see Early Burned above) is considered the most adventuresome project in the business. The average investment is around $35,000 and in the smaller firms this is usually on a contingency basis, either through royalities or revenue sharing.

Personnel Shortages. Many of the firms cited problems in finding people of the caliber and ability needed to do good educational software. Major Force went so far as to say the market expanded as they found the right person. The problem was partially mitigated by the shake-out in the industry which has made people more available. The sense is that the industry is not growing enough to put too great a demand on the need for people.

Piracy/Appropriability. Most agreed that the earlier problem with piracy has largely abated. Some still claim major losses to piracy while others believe there is very little. Others were enough of a "self-patron" that they could appreciate the societal benefits that accrued when their software was copied. This, coupled with a feeling that beyond using copy protection on disks, they couldn't do much more, produced apathy among a few respondents. Major Force went so far as to say they were considering removing copy protection from their disks. [Note: copy protection in the current environment of single, small memory, diskette based machines is not too much trouble to teachers, however, when more machines have hard disks or teachers want to network software, the problems become enormous. It was for these reasons that almost all business software today is not copy protected.]

Software firms have been quick to remedy the one problem in a small machine environment and that is provision of a backup disk in case the main disk is damaged. Most firms are now including free backup disks and some others are selling them at nominal cost.

Nondepletability. In general, the industry is too new to be faced with any serious problems of firms trying to compete against the installed base of software. The best sense of how interested teachers are in an improved version of a program is how many take the trouble to get an update. In the case of no update charge (Major Force) the update rate is 70%. When the charge is a few dollars, the update rate is up to 40%, and when the update charge is close to $10, the update

rate is 20-30%.

Intangibility and Externality. As was expected, questions about these societal concerns posed the most problem to many of the respondents. Intangibility in the parlance of those who understood the question was "perceived value." The few who grasped this concept had the sense to know how serious a question it was whether teachers and schools could translate dollars into appropriate purchasing levels. Their sense was that this was an extremely serious issue and in one case, with Filmstrip Convert, the respondent felt that it was the inability to perceive value that "has destroyed this market."

The few who understood the question about externality translated it into the concept of "veneration." It was felt that people knew how much to venerate the textbook but that computer software was too new to assess what degree of positive impact it will have on society.

Indivisibility. As discussed above, the concern for indivisibility was always from the viewpoint of whether a narrowly focused, low price software item was marketable. It was never understood in the economic sense of the "problem of indivisibility" that Arrow and others have discussed (see framework discussion).

Economies of Scale. Only Science Ed and Filmstrip Convert expressed a high concern for the economies of scale threat. Most were unperturbed and believed that to do good educational software had no economies of scale and that large firms become too bureaucratic and obstacles to innovation. [Note: a view that is supported by the above analysis of firm size versus novelty.]

Teacher Awareness. The earlier question asked about teacher's general abilities regarding the computer and to assess software. This question focussed on the problem of search — were teachers aware of the particular firm's software.

In general the answer was that those teachers who wanted to know about their software would pretty much be able to find out though with difficulty. The largest hindrance to teacher awareness was linked back to their general interest and awareness. One respondent from the filmstrip industry cited the 80-20 rule — 80% aren't interested and 20% are.

Transaction Costs. As discussed above, there were those firms that saw transaction costs as a form of market protection, ignoring the difficulties it imposed, and those that saw the many decision barriers of school systems as a serious barrier to selling product. Those who saw it as a barrier saw it as a extremely serious barrier.

Aggregate Overinvestment. For the most part firms agreed that in selected areas there was considerable overlap and duplication of software efforts. A few others disagreed and thought that each program had its own character and features, expanding consumer choice.

Intergenerational Legacy. Like the questions on externality and intangibility, this question strained the imagination of all but the respondent for Filmstrip Convert. Essentially one **cannot ask firms** that are focussed on the present about whether future generations benefiting from their pioneering efforts are being appreciated in today's school market demand.

Equity. The question on equity was something that they understood but only one firm could say they have been doing something constructive about an equity concern. Filmstrip Convert saw educational software as inherently good for remediation and thus inherently good to redress equity problems. In general, equity was of low concern.